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Cooperating with:

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2. Extension Service—by assisting in educational activities and the establishment of demonstration farms.

3. Agricultural Adjustment Administration—in bringing about a wider and more effective use of soil conservation practices.

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U. S. GOVERNMENT PRINTING OFFICE 16—22592

Save Your Soil

Contour Strip Cropping Saves Both Soil and Water

In a Conservation Program for Your Farm or Ranch

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NORTHERN GREAT PLAINS REGION
Regional Office, Lincoln, Nebr.

Conservation Folder No. 1

Contour Strip Cropping an Easy, Effective Way to Retard Run-off

When rain water is held where it falls until it is absorbed by the soil, crop yields are more satisfactory and the soil is protected from erosion. Consequently, the attack on erosion problems centers on the prevention of run-off. Contour strip cropping is one of the easiest and most effective ways to accomplish this, while block farming, with tillage operations and cultivated rows going up and down hill, is one of the best ways to increase run-off and speed up erosion. Convincing evidence of this is found in the "thin spots" caused by sheet erosion and gullies that are seen in many block-farmed fields.

SD—7678

Cornfield showing erosion between corn rows, which are planted up and down hill instead of on the contour. Up-and-down-hill farming increases run-off of precipitation and speeds up erosion.

Contour strip cropping is merely alternating control strips or bands of close-growing, erosion-resistant crops and strips of clean-tilled row crops, laid out across the slope as nearly on the contour, or level, as possible. The close-growing crops should be growing before the row crops are planted. This will save both water and soil.

The effectiveness of the control strips in retarding run-off and increasing water absorption by the soil will depend on the density and volume of the vegetation. Grass and hay crops are usually better for this purpose than small grains, but either may be used.

While irregularities of slope will usually cause some strips of uneven width, the pattern in a given field should permit rotation of the strips without materially changing the acreage of the various crops from year to year. If, however, one prefers to keep the strips of uniform width, one can seed the irregular areas to grass and maintain them as permanent buffer strips—that is, the permanent grass areas or small meadows.

The slope, character of the soil, and annual precipitation are the factors which generally govern the width of the strips, although some adjustments will be made from time to time on the basis of experience in the field. In general, however, narrow strips of about 100 feet in width

NEBR—372

Corn and small grain strip-cropped in strips of uneven width. Two seeded natural drains are visible. Permanent grass cover prevents water from cutting into them. There is no evidence of erosion whatever.

are required on steep slopes, while wider strips—up to 250 feet—may be sufficient on the very gentle slopes.

Because there will be times when strip cropping cannot hold all the water on the land, natural waterways should be kept permanently in grass to carry away the surplus safely, without erosion.

Contour tillage, careful management of the crop residue to keep it on the surface, and well-balanced crop rotations are all strong allies of strip cropping and terraces to help conserve water and soil on your farm.

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U. S. GOVERNMENT PRINTING OFFICE 16—22593

Save Your Soil

Protected Waterways in Cultivated Fields

In a Conservation Program for Your Farm or Ranch

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Northern Great Plains Region
Regional Office, Lincoln, Nebr.

Conservation Folder No. 2

Natural Waterways Through Cultivated Land Need Protection From Soil Washing

The surface of almost all cultivated land is sufficiently rolling to cause water from the heavier rains to run off from the higher places and accumulate in the lower spots. Where slopes are very gentle—not more than 1 foot of fall per 100 feet of slope—and where the run-off water moves slowly, little damage will be done to the land. If, however, the slopes are steep and the water runs off rapidly, a good deal of damage results.

The natural grass cover effectively protected waterways before the land was cultivated, permitting the water to run off the land without damaging the soil. These waterways still form the natural watercourses, but where the grass has been destroyed erosion cuts them deeper and deeper until they cannot be crossed with ordinary farm equipment. The outwash from eroded waterways is carried downstream to clog watercourses or to be deposited on crops or on land where it is not wanted.

Planted to grass, and given proper protection, these waterways can be made to produce hay and thus become assets instead of liabilities. Protected waterways also will accumulate a little silt each year, gradually filling up so that the broad stabilized bottoms can easily be crossed with farm implements.

NEBR–861

This seeded natural waterway empties into a solidly sodded area, whence the water is directed into a drop inlet tube. Run-off water will cause no gullying in this waterway.

Everything possible should be done to hold the rain water where it falls so that all of it will soak into the soil. Some of the ways to do this, which are described in other leaflets, are contour tillage, strip cropping, plant-residue management, stubble-mulch tillage, and the use of buffer strips. If not all the water can be held where it falls, then means should be provided to dispose of the surplus safely.

Grass will protect waterways and keep fields usable.—Grass, or a mixture of grass and a small amount of legumes, is the best vegetation to prevent erosion in waterways through cultivated fields. All the natural waterways should be sodded or seeded to adapted sod-forming grasses, with the seeded strips wide enough to extend well up the slope to prevent cutting along the edges. Grassed waterways may be mowed for hay but should not be pastured.

When moving farm equipment across grassed waterways, all tillage implements should be raised so that the grass will be disturbed as little as possible.

Prevent gullies by establishing grass in all natural waterways. Try protecting at least one waterway each year.

NEBR–907

A sloping grassed waterway into which a series of diversion terraces directs surplus water. The heavy sod which has formed in the waterway will prevent soil washing.

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U. S. GOVERNMENT PRINTING OFFICE 16—22594

Save Your Soil

Wildlife and Soil Conservation Go Hand in Hand

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SOIL CONSERVATION SERVICE
Northern Great Plains Region
Regional Office, Lincoln, Nebr.

Conservation Folder No. 3

Regular Soil Conservation Practices Encourage Wildlife

1. *Odd spots.*—Small, irregular eroding areas having little value for usual farm operations can be controlled by planting close-growing shrubs, grasses, or legumes, which not only check erosion but provide food and cover for wildlife.

2. *Gully control.*—In many cases fencing of the gully to protect the native vegetation is all that is necessary to control erosion and create a habitat for wildlife. In other cases, the use of close-growing herbaceous and woody plants may be necessary to supplement the native vegetation.

3. *Ponds and reservoirs.*—Fencing a farm pond and piping the water to stock tanks below the fence or to the garden for irrigation leaves the pond for fish production. The protected pond area may serve as a private or neighborhood recreation center.

NEBR–497

In many cases all that is needed to control gullies in the northern Great Plains is to protect the native vegetation by fencing out livestock. The development of a vegetative cover provides an attractive habitat for wildlife.

Fencing the upper end of a large reservoir accomplishes a similar purpose. Woody, marsh, and aquatic plantings made within the fenced area reduce wave action on the shore line and prevent silting; they also protect spawning grounds for fish and provide excellent breeding grounds for migratory waterfowl.

4. *Spring development.*—Fencing a spring also offers an opportunity to create a small area of escape and nesting cover for birds; it likewise protects the spring area from trampling and assures a clean, more disease-free water supply for livestock.

5. *Streambank and roadside protection.*—A variety of grasses, legumes, close-growing shrubs, or vines may be used to stabilize eroding streambanks and highway embankments and to provide wildlife food and shelter.

6. *Woodlands.*—Wooded areas protected from grazing and fire furnish good soil cover and a permanent home for wildlife. Shrub borders to woodlands protect the trees from the wind and offer an ideal habitat for most of our insectivorous and game birds.

7. *Shrubs and herbaceous buffers.*—Buffers conserve moisture by accumulating snow; they also check soil blowing. They afford protected avenues of travel and insure better distribution of winter food and shelter for wildlife on the farm.

8. *Shrub hedgerows.*—These furnish protection to field borders and are especially adapted to the semiarid region west of the 100th meridian and to irrigated land. Fields with hedges are known to support more pheasants than those without hedge plantings.

NEBR–988

If the farm pond or range reservoir is fenced and the water piped to stock tanks, plantings or volunteer vegetation will protect the shore line and furnish breeding places for wildlife. The pond will then become available for fish production and may provide a private or neighborhood recreation center.

9. *Field shelterbelts.*—A 5- to 7-rod field shelterbelt used on the better tree soils has all the wildlife values of shrub hedgerows. On the leeward side of shelterbelts small, nearly snow-free areas develop during the winter; these are excellent feeding grounds for pheasants and other resident birds during severe weather.

In selecting planting materials for any purpose, one should consider their adaptability to each individual site and remember that by considering also their food and cover values it is possible to create a home for desirable wildlife where none existed before.

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U. S. GOVERNMENT PRINTING OFFICE 16—22594

Save Your Soil

Range Improvement by Proper Stocking

In a Conservation Program for Your Farm or Ranch

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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Regional Office, Lincoln, Nebr.

Conservation Folder No. 4

Suggestions for Range Improvement by Proper Stocking

One of the most effective and profitable soil and moisture conservation practices that a rancher can apply to his grazing lands is to stock them each year at a rate which will not exceed their grazing capacity. Many operators unintentionally overstock their range lands and are unaware of the cumulative effects and serious consequences of such practices. The effects of such practice generally are inconspicuous and the rancher fails to recognize the condition until he is rudely awakened to the fact that his livestock are not putting on as much flesh as formerly, or that many of his better grasses have been replaced by undesirable weeds.

MONT—10147

These well-bred Herefords are the result of 211 years of selective breeding and diligent industry. The excellent range they are grazing has been maintained by careful and forthright consideration of the principles of good range management. The success of the livestock enterprise is largely based on coordination of wise animal husbandry and proper range use.

Range deterioration from continued overgrazing usually takes place in the following stages:

1. The more palatable plants are gradually replaced by less palatable ones or others that are practically worthless for feed. These less palatable plants are less able to protect the soil from loss of water and run-off than the ones they replace.

2. More of the soil becomes exposed to the damaging effect of sun and wind, and the plant material dries and blows away before becoming incorporated in the soil. Without surface litter of plant material to keep the soil pores open for the ready admittance of rainfall, much of the rainfall escapes into the drainages. In areas of low rainfall, such as the northern Great Plains, it is especially desirable to save as much of the precipitation as possible for plant growth.

3. Soil erosion slowly takes place and the top dark layer of soil is gradually lost. With this loss, the fertility gradually declines and the overgrazed range lands become less productive each year and finally reach the point where their value for grazing is destroyed.

Fortunately, the fertility of the topsoil on many of our range lands has not declined appreciably, and operators can prevent further deterioration by running fewer head of livestock. Those who adopt this practice of conservative grazing and of leaving a liberal supply of grass on the ground at the close of the grazing season will find that:

WYO—99

Sixty years of careless livestock grazing has converted this former wheatgrass meadow to a wind-blown sterile plain. There are only scattered remnants of the bluestem wheatgrass that formerly covered this spot, but the real damage has been caused by the loss of 6 to 16 inches of the former topsoil. The salty subsoils are impervious to water and consequently it may take generations of careful management before grasses can reclaim this valley.

The animals will leave the range in better condition and command higher market prices.

The grass left on the ground will give more even distribution of the snow on the area, reduce run-off and erosion, and make more moisture available in the ground for the next year's growth.

The more desirable forage plants will increase in abundance and the grazing capacity will gradually increase.

Start this year to leave more grass on the range land at the close of the grazing season. It will be a good investment.

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U. S. GOVERNMENT PRINTING OFFICE 16—22596

Save Your Soil

Strip Cropping for Control of Wind Erosion

In a Conservation Program for Your Farm or Ranch

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Conservation Folder No. 5

Strip Cropping Checks Winds' Force, Controls Wind Erosion

Soil blowing and drifting seldom present problems on land that is covered with growing vegetation or protected by a good vegetative mulch. It is only when the soil is left insufficiently covered, as for instance when lands are overgrazed or left bare after plowing or cultivation, that wind erosion occurs.

Sweeping across large expanses of bare or inadequately protected ground, the wind picks up and carries along the surface fine particles of soil. As it gathers volume and momentum, this wind-borne soil damages everything in its path until it is finally dumped in drifts in fence rows, around buildings, along highways, or in narrow tree belts in the same way that snow is piled up by the wind. Because the wind needs a pretty good run to gain the surface velocity necessary to move soil, large fields are much more susceptible than small ones to damage from wind erosion.

ND—5052

This is an excellent illustration of strip cropping on a farm near Minot, N. Dak. Wheat and fallow are alternated on this farm, whose owner declares that strip cropping not only prevents soil drifting but also has a beneficial influence on the yields.

All large fields which are subject to soil blowing should be divided into parallel strips of uniform width that run crosswise to the direction of the prevailing winds, provided contour strip cropping is not more advantageous. The strips will range from 5 to 20 rods wide, depending upon the severity of the wind erosion. Alternate strips can be kept in growing crops or stubble while the other strips are being fallowed, cultivated, or seeded.

This practice is known as wind strip cropping. It not only reduces the size of the areas exposed to the wind, but also provides barriers in the form of stubble and growing crops to check the velocity of close-to-the-ground air currents that dry out soil particles and start them moving.

In areas of specialized crops, such as potatoes or sugar beets, which do not leave enough crop residue on the ground after harvest to prevent soil blowing, fairly satisfactory results can be obtained by planting strips of corn or grain sorghum 4 to 6 rows wide and spaced 5 to 8 rods apart. These strips of tall-growing crops are left standing and, spaced at regular intervals across the fields, form barriers that reduce the velocity of the surface winds and protect the soil for the greater part of the year.

A—SD—48

This air view shows two farms in South Dakota using different rotations in strip cropping. The farm in the foreground uses alternate rows of row crop and grain crop. The other farm has a three-crop strip rotation: fall-sown grain, spring-sown grain, and a row crop. Both systems of strip cropping have been effective against wind erosion.

While wind strip cropping is a good practice in itself, it is much more effective when combined with a type of tillage that will leave the vegetation and plant residue on the surface. The individual strips usually may be made a little wider if the cultivated areas are protected by plant residue.

Stop soil blowing in at least one field each year, by farming it in strips, until all your cultivated land is protected.

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U. S. GOVERNMENT PRINTING OFFICE 10—22597

Save Your Soil

Save Soil, Moisture With Contour Tillage

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Conservation Folder No. 6

Contour, or Level, Tillage Saves Soil and Moisture

The system of plotting land in mile-square sections, with section lines running north to south and east to west over hills and through valleys and plains, is the foundation of our land ownership, farm operations, and road systems. Roads were surveyed in as nearly straight lines as the terrain permitted, farm boundaries followed the sections' rectangular form, and the section lines were guides for dividing farms into fields and for farming operations.

The practice of following section lines in farming operations works well enough on flat land but it is very wasteful of soil and moisture on sloping land, where plowing, planting, and cultivating in straight lines up and down the slope set up ideal conditions for rapid run-off of water and maximum soil loss.

SD–10236

This picture was taken in June, 19 days after a "slow" rain during which water was observed rushing down the lister furrows which had been plowed up-and-down-hill. The valuable topsoil which was washed from the field was deposited in the draw in the forepart of the picture.

Contour tillage—that is, plowing, planting, and cultivating across the slope as nearly on the level as possible—is necessary to protect the soil on sloping land. Contour tillage creates innumerable little dams or barriers to hold precipitation where it falls until it can soak into the soil. Each plow furrow, every cultivator groove, every planter or drill row becomes a tiny reservoir. Water that is absorbed by the soil is beneficial to growing crops and causes no erosion, but water that runs off is a direct loss to crops growing at the time and also impairs the productive ability of the land itself by carrying away fertile topsoil.

Besides conserving soil and moisture, contour tillage also saves manpower, horsepower, and tractor power. Why waste energy pulling heavy equipmentu p-and-down-hill and waste time shifting gears, when the operation is so much easier on the level? Contour lines should be laid out accurately with some kind of surveyor's level, and marked so they become permanent guides. The number and spacing of the lines needed for accurate contour tillage will vary with the regularity of the slope. More guide lines are needed—about one every 100 feet—on uneven land than on uniform slopes, where they may be as much as 250 feet or so apart.

SD–5100

Here is water impounded in furrows plowed on the contour, or level. The picture was taken 20 hours after a hard rain. None of the water got away from this field, nor was there any washing of the soil.

Generally there will be some irregular patches, or "correction strips," between contoured areas. In many places, planting them to grass or other hay crops will be the most satisfactory way to handle them.

To get best results, contour tillage usually should be supported by strip cropping, crop rotations, and the creation of a vegetative mulch. Sometimes terraces are advisable.

Ask your county agent or the nearest Soil Conservation Service representative about the best methods of establishing lines and farming on the contour.

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U. S. GOVERNMENT PRINTING OFFICE 16—26228-1

Save Your Soil

Establishing Grass on Unproductive Cultivated Land

In a Conservation Program for Your Farm or Ranch

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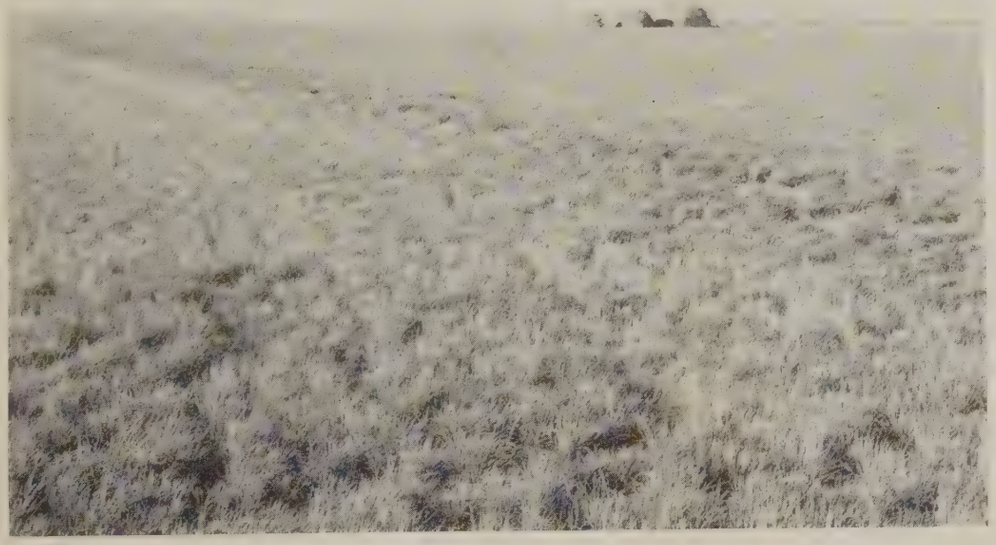
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Northern Great Plains Region
Regional Office, Lincoln, Nebr.

Conservation Folder No. 7

Regrassing Unproductive Cultivated Land for Permanent Range or Pasture

The deep, rich, northern Great Plains soils were developed under a thick blanket of vegetation composed largely of grasses. At first, plowing did little damage because the tremendous quantities of grass roots held the soil together while a fine mulch of dead grass roots kept it readily receptive to moisture, but continued cultivation gradually brought about severe erosion. Now we must return part of the cultivated land in this area to grass in order to conserve soil that still remains. Several grasses and legumes are exceptionally well adapted to the area, and a mixture of these will prevent erosion, reduce run-off, and aid in rebuilding soil fertility.



A typical established stand of crested wheatgrass after it had been cut for hay, with the stacks in the background. Crested wheatgrass is especially good in the dry-land areas in providing early spring and late fall grazing, for hay production or for seed production.

Grasses are not necessarily difficult to establish if you follow these few simple rules:

1. Select grasses which are adapted to your climate and soil.

2. Use only high quality seed, having good germination and high purity and bushel weight.

3. Start seedbed preparation a year in advance by planting close drilled or rowed Sudan grass or forage sorghum. Remove the crop of forage in late August with a grain binder, leaving 8 or 10 inches of stubble. This produces a well protected, weed-free, hard seedbed. Grass seed may be drilled directly into the stubble and crop aftermath in late September if there are 6 or 8 inches of moisture already in the ground. If moisture is less than that, planting should be delayed until late fall or very early spring. On abandoned land, undisturbed for several years and now covered with a thick crop of short weeds, drill the grass seed mixture directly into the weed cover without further preparation.

4. Cool-season grasses, such as western wheatgrass, crested wheatgrass, and smooth bromegrass, should be planted in fall or very early spring. Warm-season grasses, such as blue grama grass, side-oats grama grass, switchgrass, and big bluestem, should be seeded only in late spring, May 1 to 20, on a well-packed, weed-free seedbed.

A grass seedbed in the northern Great Plains. Snow is caught and moisture is conserved by the stubble of the preceding crop which was cut high on this field. Many of the grasses are planted in fall, being drilled directly into the firm seedbed which the stubble land provides. Stubble residue provides protective cover for the young grass seedlings.

5. Grass seeds are small and sensitive to depth of planting. Larger seeded grasses should never be covered with more than an inch of soil, while small seeded species should be covered a half inch or less.

6. Most important of all, do not become too quickly discouraged just because you cannot see a lot of seedlings the first year. Keep the cattle out, clip the weeds high starting in June. Nine times out of ten you will be surprised at the end of the second growing season at how much grass you really have.

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U. S. GOVERNMENT PRINTING OFFICE 16—26175-1

Save Your Soil

Stock Water Dams in the Northern Great Plains

In a Conservation Program for Your Farm or Ranch

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Northern Great Plains Region
Regional Office, Lincoln, Nebr.

Conservation Folder No. 8

Well-Located Water Supplies Needed by Livestock Enterprises

A livestock enterprise needs well-located water supplies. Cattle should not travel over 2 or 2½ miles to water on flat or rolling range, nor over 1 or 1½ miles in rough areas, heavy timber, or brush. About 40 acres of drainage will produce 1 acre of water a foot deep yearly in the northern Great Plains range country. A reservoir should impound water to a depth of at least 8 to 10 feet to insure a stable year-long supply.

WYO-2624

Note the flat upstream slope of this dam. The spillway is in the background. It is level, wide enough to carry flood flows, and has enough vegetation to prevent erosion.

Location of dam.—Select a site where water can be impounded deeply enough, the quantity of earth in the fill is not large, cattle can reach the water easily, and, most important, where a proper spillway can be provided. Natural spillways, that is, spillways utilizing native vegetation and natural topography (ground surfaces) give best results. The channel should be broad and flat and on a low slope to spread the water over a large area and thus reduce the danger of erosion. Where the natural surface of the ground cannot be used, a cut may be made and then revegetate the exposed surfaces. Fence the spillway to maintain a good cover of grass.

Spillway capacity.—For relatively unimportant structures whose failure will not endanger life or property, allow 1 foot of spillway width for every 5 acres of drainage area.

Freeboard.—Freeboard is the distance from the top of the dam to the bottom of the spillway and should never be less than 4 feet. Many States require a freeboard of 5 feet or more.

Core wall.—The purpose of a core wall is to stop the flow of water underneath the dam. It must be at least 2 or 3 feet deep in practically every instance and must always be sufficiently deep to block previous strata. Backfill the core with thoroughly tamped clay material.

Earth fill.—First clear the foundation of all vegetation and roots, and roughen it with a plow or disk parallel to the dam's centerline to provide good bond with the earth fill. Locate the borrow pit just upstream from the toe of the dam to increase the depth of the pond, but

SD-7814

Water is beginning to flow over the natural spillway of this dam. Note how it spreads over the flat area in a thin sheet. Spillways of this type will take flood flows without causing erosion.

take care not to open up a porous layer of earth. The fill should be built of watertight material free from sod, roots, brush, and other organic matter. Spread the fill in layers not over 8 inches thick, allowing the travel of teams and tractors to pack it. Make slopes at least 3 to 1 upstream and 2 to 1 downstream, with the dam's top at least 8 feet wide. Allow 10 percent for settling; thus a 15-foot-high dam should actually be built 16½ feet high.

Slope protection.—Generally, small dams less than 12 feet high need no protection for the earth slope, but where desired, rocks placed to a depth of 1 foot are best. Gravel placed to a depth of at least 18 inches will do, while willow, aquatic shrub and grass plantings, or placement of a floating timber boom often is enough. Seed the top and downstream slope to native grasses.

State laws.—Some States require official approval of all dams of certain classes. Investigate the laws before starting construction of a stock-water dam. The county agent or Soil Conservation Service representative will be glad to help.

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U. S. GOVERNMENT PRINTING OFFICE 16—26877-1

Save Your Soil

Stock-Water Dugouts an Aid to Range Management

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Conservation Folder No. 9

Dugouts Accumulate Run-off to Furnish Water for Range Stock

In many places a water supply is necessary for proper range utilization where the lay of the land does not lend itself to dam construction. Under such circumstances, a dugout can be built to collect and hold surface run-off. A dugout is merely a hole dug in a manner to provide adequate storage capacity. Dirt taken from a dugout is usually scattered about the border, but in some cases it may be piled on the downstream side to raise the water level above the top of the excavation and provide additional storage capacity. Where the excavated earth is utilized as a dam, provisions should be made for disposing of flood water safely.

WYO-2572

Rectangular shaped dugout. A diversion dike, not discernible in this photograph, collects water from the flat and directs it to the dugout.

Location.—Dugouts may be constructed in natural drainage channels, at the low point in a pothole, or almost any place on fairly flat land where water can be collected and impounded. Run-off frequently can be diverted from adjacent drainages to add to the water supply, but the diversion ditch should be constructed at a grade which will not cause erosion. Grades of 1 percent (1 foot drop per 100 feet of length) or less will generally prove satisfactory for this purpose. The nature of the soil at the site of the dugout should be investigated to determine whether the soil will hold water.

Construction.—A dugout should have one or more sloped entrances so that stock can utilize the water at any depth. The other sides may be made as steep as the ground will stand when the hole is full of water. Dugouts may be excavated with fresnoes or any other type of dirt-moving equipment. The earth taken out should be spread in a manner to cover the minimum of range and at the same time not be piled so high as to be unsightly or difficult to revegetate. Holes should be at least 8 feet deep in most parts of the northern Great Plains to compensate for evaporation, seepage, and use. The capacity of the ordinary dugout varies from less than

ND-302-B

Dugout constructed in the form of a cross to permit economical travel by earth-moving equipment. This type is more adaptable to the smaller structures built with a tumblebug.

1 acre-foot to about 2 acre-feet. A thousand cubic yards of excavation will provide 0.6 acre-foot of water-storage capacity.

Fencing.—Usually a fence should be built to keep the cattle away from the steep sides of the hole and to prevent their wading over the whole area. When the hole is reasonably accessible, a movable drinking rack can be installed. This can be placed so that cattle can enter the dugout only far enough to secure adequate drinking water.

If it is necessary to reduce the contamination of the pool, the water may be pumped from the dugout into tanks or troughs for the stock.

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U. S. GOVERNMENT PRINTING OFFICE 16—27876-1

Save Your Soil

Water Spreading and Flood Irrigation

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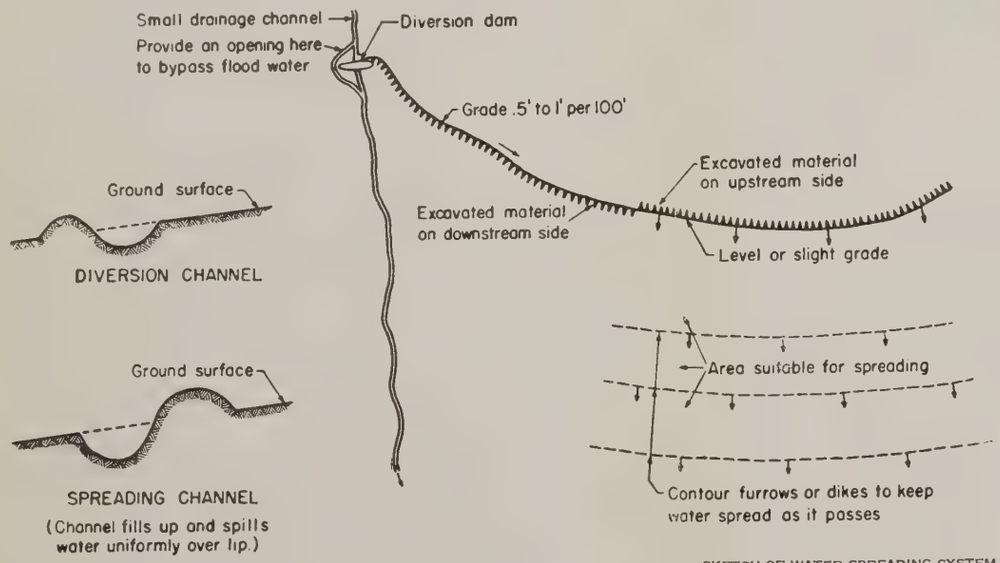
Conservation Folder No. 10

Run-off Water Diverted to Feed Croplands Increases Yields

The practice of diverting flood water or run-off from natural drainage channels and spreading it on range land pays dividends in supplemental feed. Water spreading is accomplished with a system of diversion ditches and dikes, but should be attempted only where there is a relatively small quantity of flood water and on fairly flat, uniform slopes. Water can be diverted from roadside ditches, stock-water dam spillways, small draws, or wherever there is a sufficient flow.

The diversion ditch is constructed at a grade, usually from 0.5 to 1 percent, that will collect water and move it along without causing erosion. Earth from the ditch is thrown downhill to form an embankment and give the ditch greater capacity. At the place where water is to be spread the ditch gradient is reduced or made flat, and here the excavated material is placed on the upstream side or wasted. The downstream edge of the channel is thus made approximately level so that when it fills up it will overflow uniformly for its entire length and thus spread water. After the water is spread from the upper main ditch, it may have a tendency to concentrate again and follow definite channels. Properly placed contour furrows and ditches will help keep the run-off distributed.

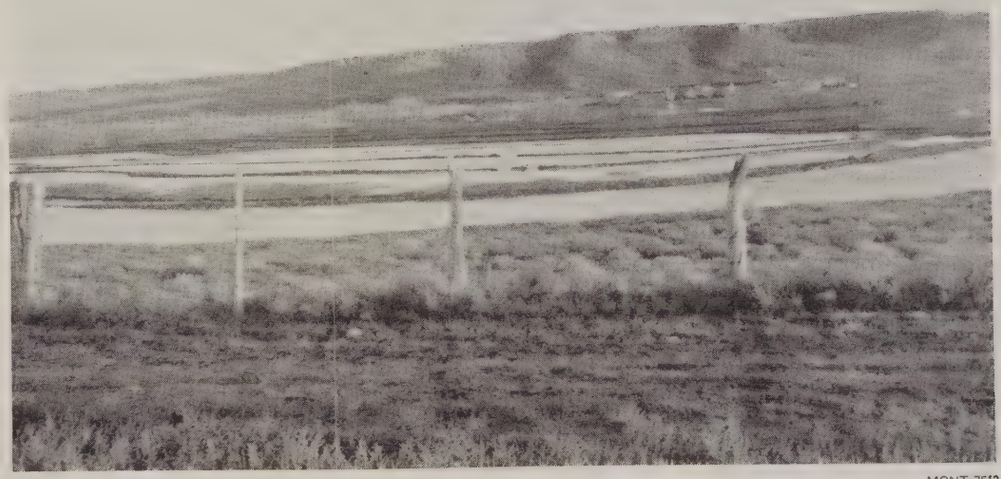


SKETCH OF WATER SPREADING SYSTEM

A typical plan for a simple water-spreading system. It can be adapted to almost any location where surplus water is available, and where the slopes are uniform and do not exceed 8 percent.

This type of spreader is well adapted to native grass slopes up to 6 or 8 percent, but best results are obtained on slopes of about 2 or 3 percent.

At some places one can use a more intensive system of water spreading which will force more water into the soil and give reasonable assurance of success with supplemental feed crops. Here the entire crop area is flooded up to depths of 6 to 8 inches, hence the name flood irrigation. Flood irrigation can be applied successfully only on lands of uniformly regular slope not exceeding 1 percent. The flood water is diverted from a natural drainage through a gate which regulates the flow, and is carried in a ditch to the area to be irrigated. This area is completely enclosed by dikes, with other dikes running across the slope so that all of the land between any two of them can be flooded. Openings are made in the dikes at fixed intervals and of a size to take the total flow at the depth of flooding. Water enters at the upper side of the area and flows down from field to field through the openings in the dikes, flooding the entire area as it passes.



MONT-7513

Flood irrigation of flat gently sloping land to increase subsurface moisture for plant growth. Layouts like this will do much to assure the growth of a supplemental feed crop under normal conditions.

The dikes are usually built about 15 inches high and to a shape that permits machinery to operate over them. The earth used to build the dikes is always taken from the downward side.

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U. S. GOVERNMENT PRINTING OFFICE 16—26875-1

Save Your Soil

Developing Springs to Furnish Water for Livestock

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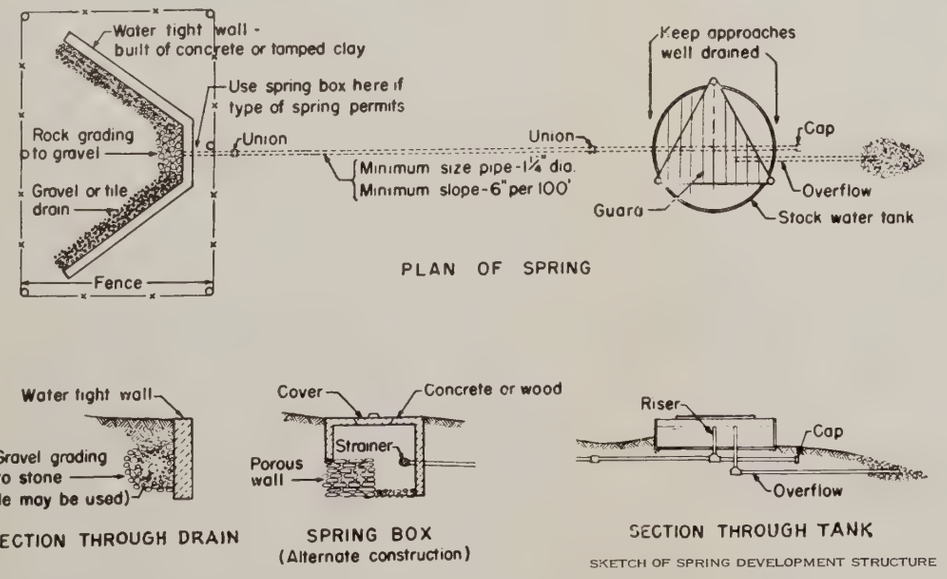
Conservation Folder No. 11

Two Types of Springs Require Different Treatments

This discussion covers spring developments for livestock purposes only. Developments for human use involve strict sanitation requirements.

From the standpoint of development, springs are of two types. In the first, water appears at the surface over an extended area, usually as a boggy seep from an outcropping of the water table or from water-bearing material that is under pressure. The second type is characterized by a concentrated flow from a fissure or a sand-and-gravel layer that is between layers of clay or other water-tight material.



A plan view and section of a spring development. A section through a spring box is shown. It may be substituted for the collection gallery when the spring flow is concentrated at one point.

Development of the first type of spring usually requires construction of a water-tight wall at right angles to the direction of flow, to concentrate the water at one point whence it can be directed to the supply tank or other point of use. The wall may be of concrete or well-tamped clay, and needs be carried only deep enough to obstruct the flow of water in the water-bearing material. It should be sealed to water-tight banks, if they exist; otherwise, it should be extended as far as necessary to collect the desired amount of water. A gravel or tile drain upstream from the wall is desirable to intercept the maximum flow and direct it to the outlet. If the area covered by the spring is subject to overflow, a cover of concrete or rock will add to the life.

To develop the second type of spring, merely make an excavation at the source to assure an unrestricted discharge and construct a box over the point of flow to protect the outlet and concentrate the water and permit it to be directed to a tank. The spring box may be concrete, rubble masonry, timber, a length of corrugated pipe, or any other suitable material. A cover should be provided to permit inspection and occasional cleaning of the spring.

Galvanized iron pipe, set below the frost line, is preferred for carrying water from the spring to the supply tank, although short pipes placed above the ground at a steep grade and

MONT-3521-C

Watering tank built directly at a spring outcrop. The spring enters the tank through the loose rock wall. Waste water is carried off through a pipe.

discharging a good flow normally will not freeze. The pipe should enter the spring at practically the water level that existed before it was developed. If a head is built up, the spring may appear elsewhere and thus destroy the value of the development.

Fence the spring and supply pipe, if it is exposed, to keep cattle away. The tank should be on a slope which will provide free drainage, should be above the high-water line of flood flows, and have an overflow pipe which will carry the water far enough away so that there will be dry footing around the tank.

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U. S. GOVERNMENT PRINTING OFFICE 16—27740-1

Save Your Soil

Tree Shelterbelts or Windbreaks Helpful On the Northern Great Plains

In a Conservation Program for Your Farm or Ranch

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Northern Great Plains Region
Regional Office, Lincoln, Nebr.

Conservation Folder No. 12

Windbreaks Protect Homes, Feed Lots, Cultivated Land, and Crops

There is a place for some tree and shrub plantings in every part of the northern Great Plains to protect the homesite and feed lot or cultivated fields and growing crops, to control gullies and stream banks, or as a wood lot.

A windbreak to protect the home, livestock, garden, and orchard is one of the most valuable improvements for a farm or ranch in the northern Great Plains. It breaks the winds' force, traps snow, supplies wood and posts, affords a home for wildlife, and beautifies the place.

Protected by a windbreak, a farm home is more comfortable and can be heated more easily and cheaply. In many places a farm garden is impossible without windbreak protection to

ND-19

Field shelterbelts have a decided influence in checking the force of destructive winds which cause soil drifting, blow out seed, or blast young crops. They modify the hot dry winds which dry out the soil and wither growing crops.

check hot drying winds or increase soil moisture by drifting snow on the garden site. Windbreak-protected feed lots and barnyards are more comfortable for both man and beast in winter, and livestock can be kept in better condition with less feed.

Field shelterbelts help northern Great Plains farmers do two major jobs—reduce soil blowing and conserve moisture. They check the force of destructive winds which cause soil drifting, blow out seed, or blast young crops, and also modify the hot south winds which dry out the soil and wither growing crops at critical stages in their development.

Shelterbelts, primarily for the protection of cultivated fields, can be established successfully on irrigated lands and on the lighter soils wherever the continuous production of agricultural crops is feasible, but on heavy soils where normal precipitation is less than 17 inches, field windbreaks are not generally successful unless they are of the hardiest species, get special care, and receive supplemental water which might be diverted into the planting from roadside ditches, natural drainages, or contour furrows and terraces.

To establish trees and shrubs successfully:

1. Select the site carefully and prepare it well by thorough tillage to control weeds; if necessary fallow the site or grow a row crop for 1 year to increase soil moisture.
2. Use hardy and adapted varieties of trees and shrubs which have been grown from seed collected in the general climatic locality in which the planting is made.

SD-7581

One of the greatest assets that can be added to a farm is a windbreak protecting the buildings. A large number of owners of farmstead windbreaks in North Dakota were asked to place a value on tree plantings. It is significant that their average value was $1,000 per farm.

3. Plant carefully and use a mixture of species.
4. In the drier portions of the Plains, plant along natural drainages so as to take advantage of the additional moisture.
5. Cultivate well as long as weeds and grasses persist.
6. Exclude livestock permanently.
7. Provide ample protection from fire.

Where rainfall is low, soils heavy, or water erosion severe, planting and cultivation on the contour is especially desirable to check runoff and provide more water for the trees. Water diversion, flood irrigation and water-spreading devices, and small terraces can be used in many places.

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U. S. GOVERNMENT PRINTING OFFICE 16—27741-1

Save Your Soil

Protection and Care of Farm Woods

In a Conservation Program for Your Farm or Ranch

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UNITED STATES DEPARTMENT OF AGRICULTURE
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Northern Great Plains Region
Regional Office, Lincoln, Nebr.

Conservation Folder No. 13

Value of Farm Woods Can Be Increased by Simple Methods

In the northern Great Plains, the value of farm woods is measured by its capacity to control erosion, serve as a windbreak, produce wood products, and harbor insect-eating birds and other wildlife. Usually the most neglected field on the average farm is the one devoted to growing trees, but its value can be improved greatly by simple methods.

Woodlands, if they are handled in the right way, have a stabilizing influence on the productivity of the land. They protect the soil and crops in adjoining fields and conserve moisture. Protected from fire and cut wisely, ungrazed farm woods will gradually develop into a valuable

ND-10

Well-managed farm woodlands have an understory of small trees resulting from natural reproduction and a good distribution of medium age classes.

asset which will contribute directly to the farm income, as well as make the farm and community a more pleasant place.

The trees actually enrich the soil, instead of depleting it. Tree roots bring plant food up from the lower depths of the soil and deposit it on top of the ground in the form of fallen leaves and twigs. (Most of the mineral foods from the soil are found in the leaves and twigs; the trunk and larger limbs of a tree are formed mostly of material drawn from the air and converted into wood through the use of sunlight and water.) The litter formed by fallen leaves and twigs, if left in place to decay, makes a natural porous, absorbent mulch in which is to be found many beneficial insects, earthworms, and bacteria busily developing soil and keeping it open and porous. This facilitates the percolation of water into the ground rather than allowing it to run off.

The value of the wood products from a farm woods, if only for fuel and posts, is greatly appreciated by the northern Great Plains farmer. Many farm homes have been heated throughout most of the drought years by wood from dead and dying trees, thus making unnecessary a cash outlay for purchased fuel. Furthermore, wood cutting on the farm can be done in winter when other work is slack and thereby be a source of income in the form of labor.

Unrestricted grazing by livestock is the most serious abusive practice to which farm woods have been subjected. Livestock and trees cannot thrive on the same ground, and besides, the forage that grows under trees is of decidedly poorer quality than forage growing in the open and sometimes is worthless.

Stock trample the soil and compact it so that air is excluded and its moisture-absorbing qualities are destroyed. No natural mulch of leaves can exist under such conditions, and natural reproduction is impossible. Livestock promptly browse, trample, and break any young trees which may start from seed or sprouts from stumps, and when these are gone, they consume the lower branches of older trees. The result is an open woods, through which the wind can blow with ease. This prevents the accumulation of moisture in the form of snow, while on steep slopes erosion sets in, and forest and soil both soon deteriorate.

Indiscriminate cutting of the best trees or of post-size trees without leaving sufficient young growing stock creates a woods made up of old, deformed, scrubby trees of little value. A wise farmer removes the crooked, undesirable trees first to make room for the more rapid growth of the straight, desirable specimens.

To improve the returns from farm woods:

1. Protect it from livestock, permanently.
2. Cut old, crooked, diseased, defective, and undesirable trees first.
3. Plant a border of shrubs or low growing trees around the woods, to check surface winds, catch snow, and improve moisture conditions.
4. Leave seed trees of desirable species and underplant where conditions will permit.
5. Cut lightly over a large area and do not leave open spots or holes; keep the woods as dark as possible.

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U. S. GOVERNMENT PRINTING OFFICE 16—27783-1

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Tree Planting to Stabilize Gullies and Stream Banks

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Conservation Folder No. 14

Trees Restore Waste Land in Gullies to Usefulness

Much of the wasteland to be found in the northern Great Plains has been made waste through the formation of gullies and "cut banks" along drainages. Year by year, raw gullies are cut deeper and uncontrolled stream beds are broadened. Many fertile acres are lost in this way, fields become divided, and the value of the farms gradually decreases.

The first step to control a gully is to divert the water flowing into it, then to surround it with a fence to keep livestock away, since continuous grazing destroys the protective vegetation and thus keeps banks raw and easily eroded, encourages the development of side gullies, and accelerates the sloughing off of steep banks.

NEBR-73

Gully and "feeders" cutting through fertile northern Great Plains farm, photographed in 1936. It certainly was not a farm asset, but virtually wasteland, returning no farm income, protecting no wildlife.

However, unused land becomes wasteland. One of the best ways to restore such wasteland to the status of profitable producing units is to plant them to trees and shrubs, thereby controlling erosion and at the same time establishing windbreaks for the protection of adjoining fields, wood lots capable of producing posts and fuel wood and perhaps a few sawlogs, and wildlife refuges which will furnish food and shelter for insect-eating and upland game birds.

Possibly not all parts of the enclosed areas can be planted to trees and shrubs. There may be some spots which are covered with a good sod of native grasses, which should not be disturbed. It is extremely difficult to establish trees in sod, but where gullying and bank cutting are active and raw soil is exposed or has nothing but weeds growing on it, the planting of woody vegetation is usually the quickest, easiest, and in the end the most profitable way to bring such areas to a stabilized condition.

The pictures on this page show what tree planting can accomplish. The gully was planted in the spring of 1936 and in less than 2 years the vegetation had completely stopped erosion. By the third year, a complete forest and shrub cover had become established, which promises by the seventh year the opportunity to harvest black locust posts. From the end of the first year the planting has been a good wildlife habitat. The thinnings which can be made along with the harvest of posts will make good fuel, and eventually the cottonwood, elm, and hackberry trees will provide a few sawlogs from which rough lumber may be cut for repairs to farm buildings and for new construction.

NEBR-73-B

Same place as shown in the other picture on this page 4 years later. Cottonwoods are over 20 feet tall; in another 4 years the farmer can cut black locust posts. The gully is controlled, the trees provide a home for several kinds of wildlife.

If the planting is protected from grazing and fire, the harvesting of wood products is done intelligently and carefully, natural reproduction from sprouts and seed will provide a new crop for future harvest.